Forensic Evaluation of Video Footage from the TIGHAR 2010 and 2012 Nikumaroro Expedition- Supplemental Report

By: John D. Jarrell, PhD, PE

February 28, 2014

Supplemental Report

Introduction:

This is a supplement to our prior report. Positively identifying wreckage of historical significance, located in a remote area of the planet and under hundreds of feet of ocean waters is challenging and requires a scientific approach to methodology. Photointerpretation, as explained by the forensic image analysis expert working with TIGHAR, Jeff Glickman, includes taking the following list of items into consideration[i].

1. Differences in organic (natural) vs. man-made shapes.
2. Texture differences between objects within a neighborhood.
3. Pattern differences between objects within a neighborhood.
4. Color differences within multiple color spaces within a neighborhood.
5. Color absorption differences (spectrometry) between specific objects.
6. Temporal similarities vs. differences between video frames.
7. Object size and scale information which may be relative, absolute and ratiometric (mensuration).
8. Object interaction with its environment.
9. Location information including absolute position, relative position and context.

Methods:

Our team's methodology began with a frame by frame review of the underwater videos of the proposed crash site provided by TIGHAR, dated 2010 and also reviewed 2012 footage. These were viewed to visually identify potential objects associated with the Lockheed "Electra" Model 10E, Construction Number (c/n) 1055 aircraft, cabin contents and the crew members Amelia Earhart and navigator Fred Noonan. The potential candidates included those suggested by our team members and others identified by other individuals in public forums. A full range of items from specific plane parts to highly speculative and imaginative proposals were given consideration. From this group of potential candidates, those most suited for evaluation by mensuration, where selected for geometric comparison with specific objects or parts associated with the aircraft and it's last flight. Multiple still frames of video were captured for the proposed objects and the proposed object outlined by a Professional Mechanical Engineer using computer drawing software (Microsoft Office Professional 2010). We relied upon historical photographs of the plane and of objects similar to those which were in the original plane for establishing the relative size and geometry of objects. Since the original blue prints of the plane were not available, we made use of the limited edition scale drawings completed by aircraft modeller

William F. Harney in 2002 and published by TIGHAR in 2009. To corroborate the drawings and historical photographs, we inspected and photodocumented two of the approximately twelve Lockheed Electra Model 10s currently in existence. One of the documented aircraft was as a Model 10A, c/n. 1052, located at the New England Air Museum in Windsor Locks, CT, the second was the only remaining Model 10E, Electra, c/n 1042, owned by, Grace McGuire of San Diego, CA. The McGuire Electra also had disassembled parts of the front and rear landing gear available for inspection and photography. The geometry of specific engineered plane parts was outlined with software to convert them into line drawings. These geometric shapes and outlines of actual parts were rotated and superimposed on the line drawings made of the proposed objects from the high resolution video still images. A modified superimposition method was performed by optimally translating, rotating and uniformly scaling the line drawings taken from actual plane parts to obtain the best fit with the line drawings made from the proposed objects in the video. That is, the two sets of drawing were used to determine if multiple geometric elements were a good fit. Multiple sets of drawings taken from the separate video still images were compared to the line drawings of the actual objects. The relative size and shape of multiple geometric elements were used to positively identify geometric congruence between proposed object and actual plane parts.

The front and rear landing gear assemblies were modeled using computer aided design (CAD) according to historical photographs taken of Amelia Earhart's Electra Model 10E aircraft, measurements taken from Grace McGuire's Electra 10 aircraft, and tire information from Earhart's aircraft inspection (Figure 3). The CAD models were overlaid on the 2010 1920x1080 rover footage and fit using a perspective view. Two plausible fits for the tailwheel are shown. Using the dimensional information available in the CAD model and the assumption that the wire was on the same plane as the bottom of the CAD assemblies resting on the sea floor, the wire was calculated to have an average width of 0.72" with a combined standard deviation of 0.06" for the tailwheel and an average width of 0.78" with a standard deviation of 0.05".

It was important to consider the possibility that objects observed on the slopes of the atoll were natural formations, derived from the coral reefs growing in shallower water. The accretion of reefs by corals and other organisms produces limestone objects that can be mistaken for man-made objects, particularly when broken and eroded over time. A specialist in coral reef ecology also reviewed the video and still images to identify objects least likely to be natural and to confirm that the objects positively identified by mensuration as corresponding to parts of a Lockheed Electra Model 10, were not merely natural formations and creatures mistaken for man-made objects. The specialist was also relied upon to comment on the effects of encrustation of natural debris and man-made objects over time.

Examples of historical objects superimposed upon the video are presented in the Figures Section.

Conclusions:

From our review of the data, we have the following conclusions in regard to the 2010 TIGHAR video footage:

1) In addition to the rope/cable and wire clearly seen in the video from 2010, there are other objects observed which are man-made, by virtue of the fact that they are inconsistent with natural formations as previously determined by an Aquatic Ecologist, Prof Graham Forrester, PhD;
2) There is an object consistent in shape and geometry with a tailwheel as determined by geometric comparison with the tire and fork from a Lockheed Electra Model 10.
3) There is a collection of objects atypical of naturally occurring formations in some details of shape and coloration, but consistent with the front landing wheel, worm gear and strut assemblies; This object was determined to be more likely man-made than a naturally occurring formation. Our observation from the 2010 video are consistent with representation made in the TIGHAR bulletin concerning the 2012 video, where it states, "We have located a man-made debris field that is in the location that was expected and for which the shapes of the objects in the debris field are consistent with the object(s) seen in the Bevington image." [ii];
4) There is a separate debris field, approximately 400 meters from this location with objects from a known shipwreck (S.S. *Norwich City)*;
5) The investigations of this region of the ocean floor and debris fields by the TIGHAR organization did not demonstrate migration of the S.S. *Norwich City,* shipwreck debris to the second location;
6) The objects in the 2010 video are not consistent with the objects from the shipwreck hull and superstructure debris field located approximately 400 meters away;
7) The objects we have identified in the 2010 video footage are consistent with parts of the Earhart Lockheed Electra Model 10 and, in the absence of an alternative explanation for the source of those objects, we conclude that they are likely to have originated from Earhart's Electra.

Sincerely,
Materials Science Associates, LLC

John D. Jarrell, PhD, PE
Materials Science & Mechanical Engineer
Doctor of Medical Science & Biology

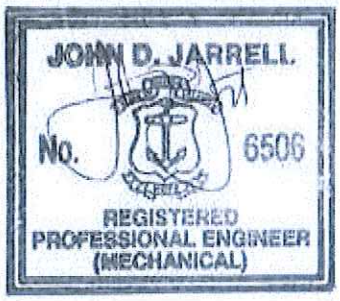

Figure 1: This composite image from the 2010 1920x1080 rover footage, created by Fatih Calakli, illustrates the proximity of the front and rear landing gears.

Form 60
Revised 10-30-35

DEPARTMENT OF COMMERCE
BUREAU OF AIR COMMERCE

COMMERCE No. NR-16020
SERIAL No. 1055
DATE 5-19-37
Approved—Disapproved—Reinspect:
Inspector.

AIRCRAFT INSPECTION REPORT

OWNER AMELIA EARHART.

ADDRESS 50 W. 45th.St. New York, N.Y.

Original license—Renewal—Export—(Alteration) (Circle which) (submit drawings)—Special. After accident of ..... (Date)

Manufacturer Lockheed Aircraft Corp. Model 10E Spec. Specification No. 590

Open (Cabin)—Amphibian—(Landplane)—Seaplane—Flying boat—Biplane—(Monoplane)—Autogiro—Glider. (Circle which)

ENGINES

MANUFACTURER	LOCATION	MODEL	SPEC. NO.	SERIAL NO.	H. P.
Pratt & Whitney	L.H.	S3H1	143	6150	550
" "	R.H.	"	"	6149	550

PROPELLER — HUBS—SPEC. NO. 257 — BLADES—SPEC. NO. 301

MANUFACTURER	LOCATION	MATERIAL	Model	Serial No.	Model	Serial No.
Hamilton Standard	L.H. (Con. Spd)	Metal	12D-40	26334	6095A-6	66570-71
" "	R.H. " "	"	"	26333	"	65672-73

Number of fuel tanks 12 Location and capacity of each 2 @ 81, 2 @ 16, 2 @ 102, in wing stubs. Total 1151 gal. 2 @ 118, 3 @ 149, 1 @ 70 in fuselage. Total oil capacity 80 in 4 tanks

Passenger seats actually provided 0 Crew 4 Are dual controls installed? Yes Removable? No

Weight empty as equipped—Actual—Computed (Circle which) ..... pounds. Gross weight ..... pounds.

Maximum pay load ..... pounds with fuel of ..... gallons.

Maximum pay load ..... pounds with full fuel tanks of ..... gallons.

Cargo space—Location and capacity of each none

Are compartments placarded for loads as shown?

Restrictions Restricted to long distent flights. Only bona fide members of the crew to be carried.

ALL EQUIPMENT AND WEIGHTS thereof included in empty weight MUST BE SHOWN.

Engine ring cowl	lb.	Flares and holders	lb.	Fire extinguisher	lb.
Starter (type?)	lb.	Location		Heater	lb.
Generator	lb.	Radio	lb.	Toilet equipment	lb.
Wheel streamlines	lb.	Location			lb.
Battery	lb.	Radio bonding	lb.		lb.
Location		Radio shielding	lb.		lb.
Landing lights	lb.	Water container	lb.		lb.

If inspection after accident, underscore classification which applies:
1. Major repair (see Aero. Bulletin 7-H—Current Issue). Attach Form 466.
2. Minor repair (see Aero. Bulletin 7-H—Current Issue).

IMPORTANT.—All questions must be fully ... marks will not be accepted. Disapprovals must show

11—11302 20 [OVER]

Figure 2: Amelia Earhart's aircraft inspection report dated 5-19-1937 indicating the condition of her plane.

OK PILOT'S COCKPIT.—Are airspeed indicator, manifold pressure gauge, and tachometer marked to agree with placarded aircraft operation limits as listed on pertinent aircraft specifications? Yes Yes No ~~Xxx~~ (If not, see that they are properly marked at once. *Cross out* items not required to be marked.) Approved safety belt installed each seat? Yes

None PASSENGER'S COMPARTMENT.—Approved safety belt installed each seat?

OK STABILIZER, ELEVATORS, AND RUDDER.—Approved position light? Yes. Grimes

OK LANDING GEAR WHEELS (Manufacturer, model, and size) Goodyear 6HBA

Tires (size and ply) 35x15-6. 8 Ply. Goodyear

Shock struts (manufacturer and model) Aerol SP400E

Tail wheel (manufacturer, model, and size) Goodyear 3TWA. Tire:Gdyr. 16x7. ~~Tire~~id 4 Ply.

~~Skis~~ manufacturer, model, and weight)

~~Floats~~ (manufacturer and model)

OK CENTER SECTION AND FUSELAGE OK

WINGS

Left lower OK

Left upper Low wing monoplene

Approved position lights? Yes

Right lower OK

Right upper

Approved position lights? Yes

OK POWER PLANT AND INSTALLATION OK

Total aircraft flight time 181:17 Flight time since overhaul 0

Total engine time 182:42 Flight time since engine change or overhaul 0)

Total propeller time 182:42 Flight time since propeller disassembly and inspection 0

REMARKS:

NOTE.—If space provided is insufficient for full statement of result of inspection, additional data may be shown on extra sheet.

Figure 3: Amelia Earhart's aircraft inspection report dated 5-19-1937 indicating the condition of her plane and size of the front wheel and tailwheel.

Figure 4: CAD model based on Earhart photo with 16 inch wheel (Earhart inspection report).

Figure 5: The rear landing gear with Amelia Earhart prior to her Miami departure. (http://tighar.org/Projects/Earhart/Archives/Research/Bulletins/05_Skullduggery/05_Skullduggery.html). Photo from: http://tighar.org/smf/index.php?topic=571.165

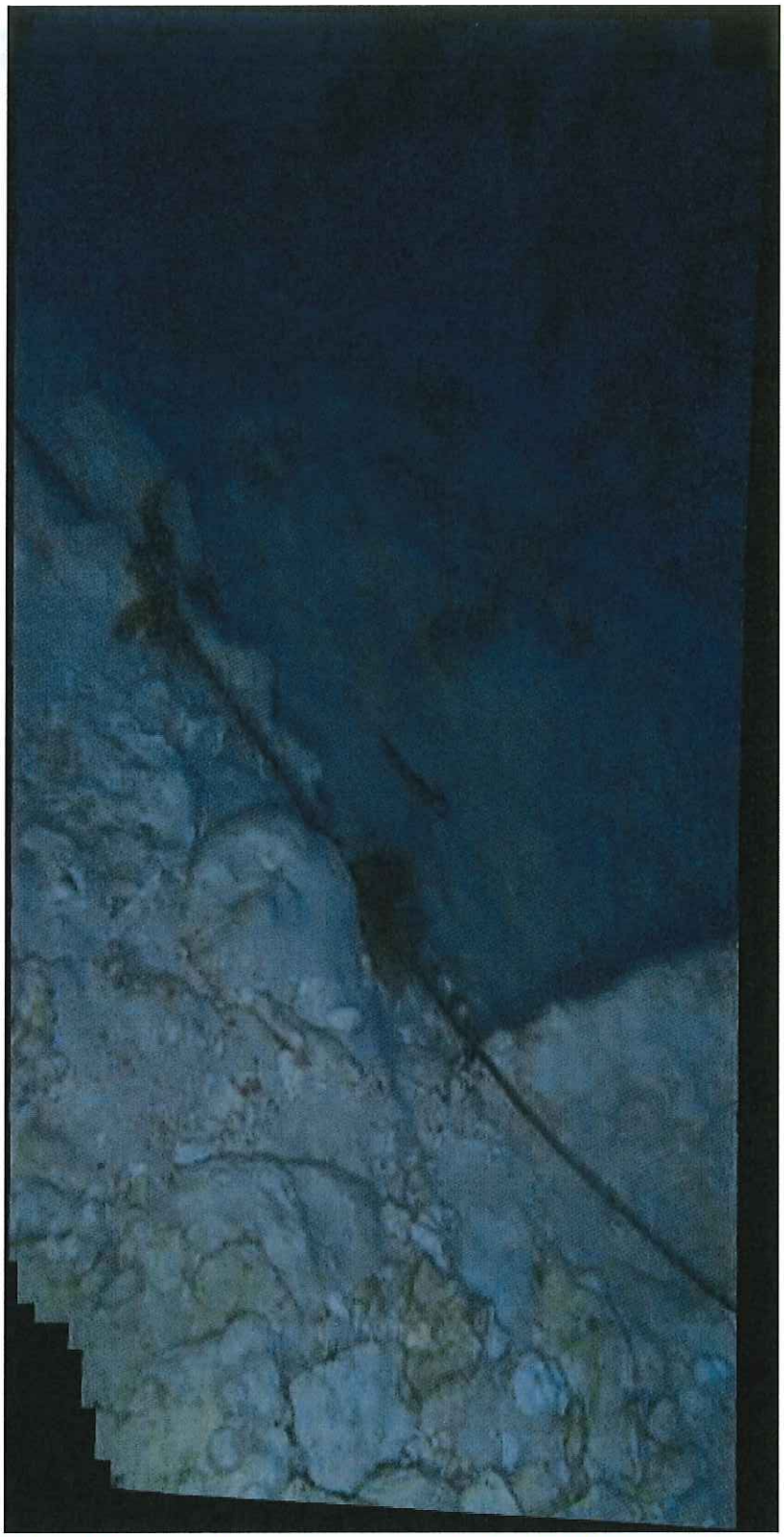

Figure 6: A composite image of the proposed rear landing gear from the 2010 1920x1080 rover video, created by Fatih Calakli; 33737.png.

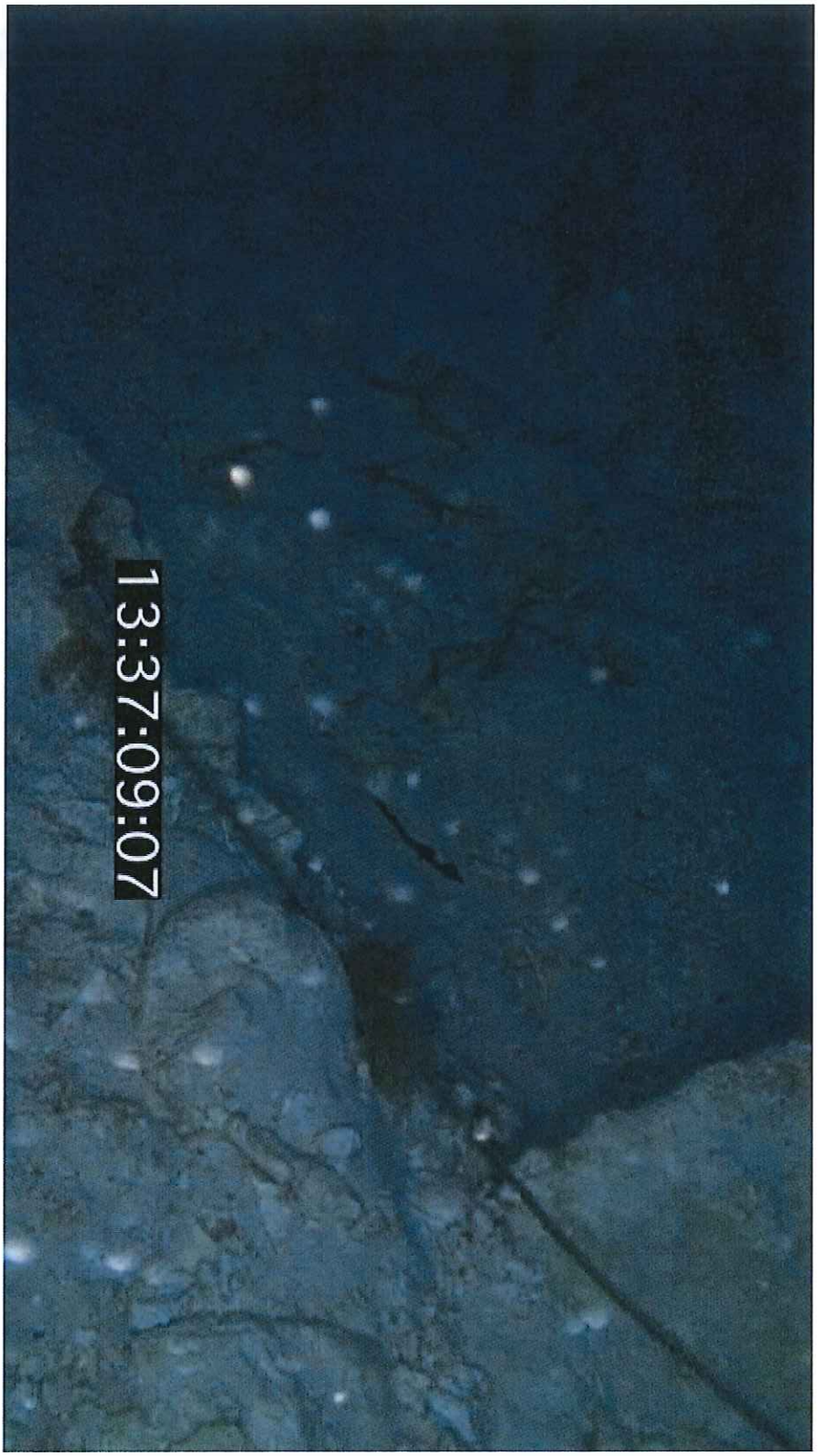

Figure 7: Still image of the proposed tailwheel from the 2010 1920x1080 rover video.

Figure 8: Five segments of the wire were bounded by rectangles, representing the cross-section of the rope. The rope was calculated to have an average diameter of 0.68" with a 0.01" standard deviation based on the CAD model of the tailwheel.

Figure 9: Five segments of the wire were bounded by rectangles, representing the cross-section of the rope. The rope was calculated to have an average diameter of 0.76" with a 0.07" standard deviation based on the CAD model of the tailwheel.